

Glider Observations of Circulation Around an Island

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Award Number: N00014-13-1-0481

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LONG-TERM GOALS

A continuing interest in oceanographic research involves the observation and prediction of coastal circulation. A special branch of the coastal problem involves circulation around islands, which has been less studied over the years. Island circulation is distinguished from continental coastal circulation primarily by an island's small size relative to the scales of atmospheric forcing and general ocean currents. Relevant processes include boundary currents, eddies shed in the island's wake, and island coastally trapped waves. This project aims to improve the understanding of island circulation through observations using underwater gliders, with the ultimate goal of better prediction.

OBJECTIVES

Given a goal of quantifying island circulation, a sensible approach is to address the hierarchy of issues. The steady circulation around an island is a result of the large-scale wind field, and the oceanic general circulation in which the island is embedded. First, we plan to address the so-called "island rule" (Godfrey, 1989) which supposes flow on the east side of the island is due to the integral effect of wind stress curl to the east of the island across the entire ocean basin. Second, we will address the effects of local wind may also force boundary currents on all sides of islands. Third, we expect wakes of eddies given that islands are often embedded in a larger-scale flow. Finally, we will examine the possibility of quantized coastally trapped waves, as imposed by the requirement that an integral number of wavelengths equal the distance around the island.

APPROACH

We are making Spray glider observations from Palau to resolve the phenomena described above. We have extensive experience deploying gliders from Palau as part of the Origins of the Kuroshio and Mindanao Current project, making for convenient logistics. Palau is embedded in strong globally important currents, with the westward North Equatorial Current to the north and the eastward North Equatorial Counter Current to the south. Because of this unique location, Palau is an ideal laboratory for studying the complete suite of island circulation effects.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 SEP 2014		2. REPORT TYPE		3. DATES COVERED 00-00-2014 to 00-00-2014	
4. TITLE AND SUBTITLE Glider Observations of Circulation Around an Island				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of California San Diego, Scripps Institution of Oceanography, 9500 Gilman Drive, La Jolla, CA, 92093				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

WORK COMPLETED

We have done four Spray glider deployments during the past year, focused on observing the boundary currents on the east side of the island. The gliders are occupying two lines perpendicular to shore, one northern and one southern on the east side. In addition to the standard Sea-Bird CTD and Seapoint fluorometer, each glider is carrying an ADCP to measure profiles of velocity to as deep as 1000 m. The intention is evaluate the efficacy of the “island rule” along the coast of Palau. To date, we have collected over 190 glider-days of data with over 1000 profiles towards this end.

RESULTS

An example of one of the sections of glider-measured velocity is shown in Figure 1. The northward western boundary current is evident. At this early stage of the observations we cannot make any broad conclusions, although it is clear that the boundary current is always present but quite variable in direction. In addition, the boundary current can be in opposite directions on the northern and southern flanks of the island. If fully successful, these data will comprise the most extensive sections of boundary current flow ever measured around an isolated island.

IMPACT/APPLICATIONS

All temperature and salinity data from gliders has been sent to NAVO in real time for assimilation into operational models.

RELATED PROJECTS

This project has benefitted directly from the logistical support established by the Origins of the Kuroshio and Mindanao Current (OKMC) DRI. OKMC gliders took relevant observations as they awaited recovery off the coast of Palau, and these data helped to form the hypotheses that motivate this project.

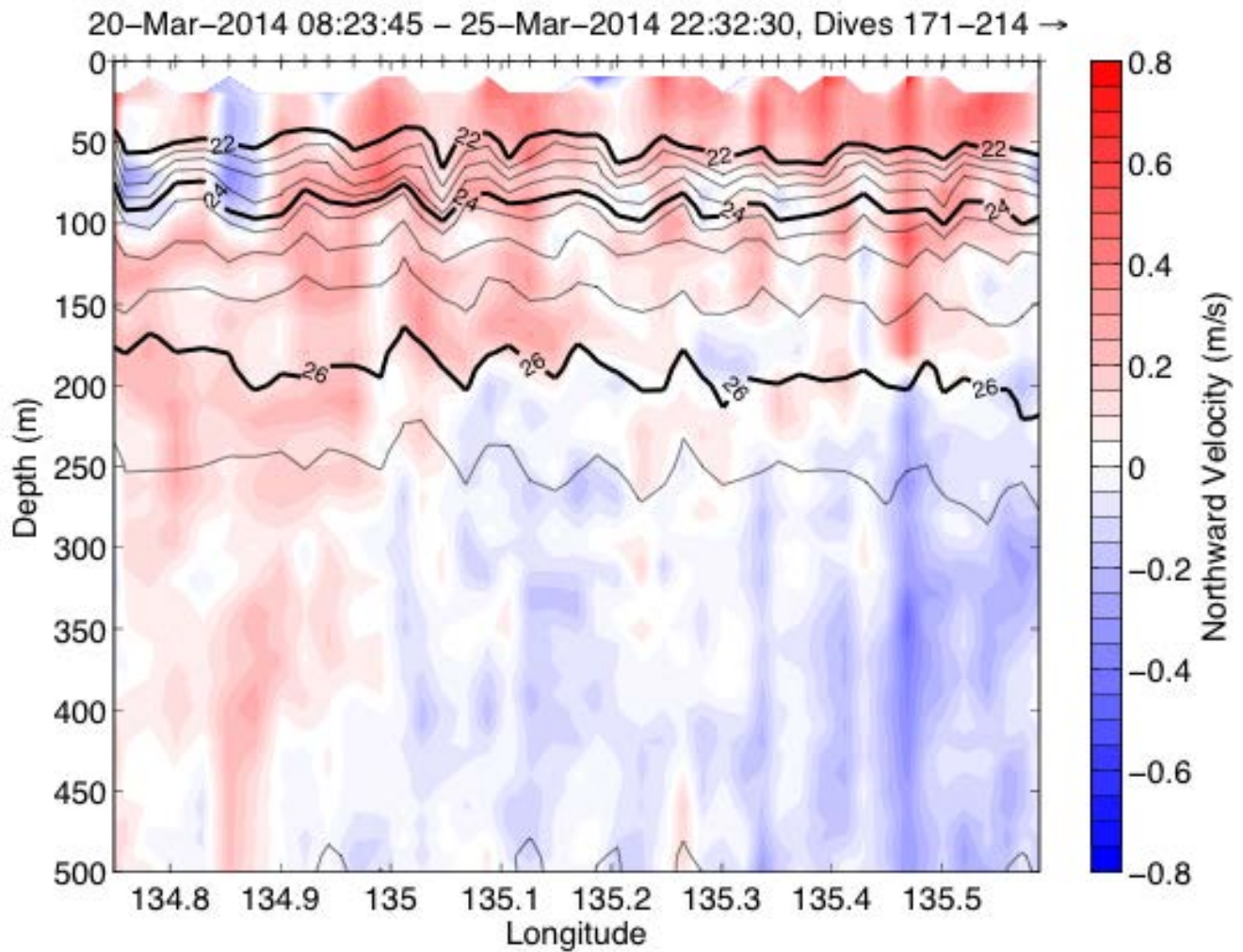


Figure 1. Section of northward velocity (color shading) and potential density (black contours) on an east/west line on the east coast of Palau (the coast is on the left edge of the section). Velocity is measured by an ADCP mounted on a Spray glider. Note the northward flow on the left side of the section, near the island, comprising the western boundary current. A question to be addressed is whether this flow obeys the island rule. Internal tides are evident as undulations in the isopycnals.